APPENDIX 5. Worksites in Focus

This appendix reviews several actual projects funded through the Pennsylvania Dirt and Gravel Road Program, as described in Appendix A-1. The first worksite on Red Rose Road was a Demonstration Project for the Pennsylvania Dirt and Gravel Road Program that became the "Drive Thru Classroom Self-Guided Tour" Project to demonstrate various environmentally sensitive maintenance practices being taught to local governments under the program. The next two worksites were actual projects undertaken by Pennsylvania local governments with major funding through the Pennsylvania Dirt and Gravel Road Program. At each local government worksite, the problem(s) is identified, with objectives, considerations, and solutions, followed by a cost summary for the project. The accompanying photos give an insight into the before and after conditions at each site, demonstrating the benefits of using environmentally sensitive maintenance practices to the road and the environment and to the overall aesthetics and to a better community.

raising the road profile before, during & after

Please contact the center with any questions:
toll free: 1-866-668-6683
e-mail: dirtandgravel@psu.edu

For more information visit:
www.dirtandgravelroads.org

Center for Dirt and Gravel Road Studies

environmentally sensitive

maintenance

red rose road

Drive-Thru Classroom Self-Guided Tour

The Problem:

Because the road was lower than the surrounding terrain, rainfall and runoff were captured and concentrated in the roadway, gaining energy and eroding road surface and bank materials. This concentrated flow exited the road with tremendous force, directly into the stream. The stream, consistently inundated with a high-velocity input of sediment-laden water, was eventually incised to the point that it was totally disconnected from its floodplain.

The Solution:

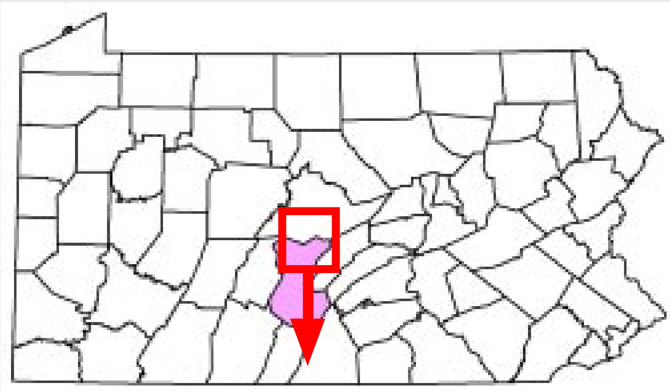
The road profile was raised to elimimate ditches and allow road runoff to flow gently from the road surface into the surrounding porous forest soils. One particularly problematic section of road was shifted uphill, away from the stream, to protect an already damaged and fragile stream reach from further harm. Selective thinning of the tree canopy allows the road to dry out while promoting healthy forest growth patterns.

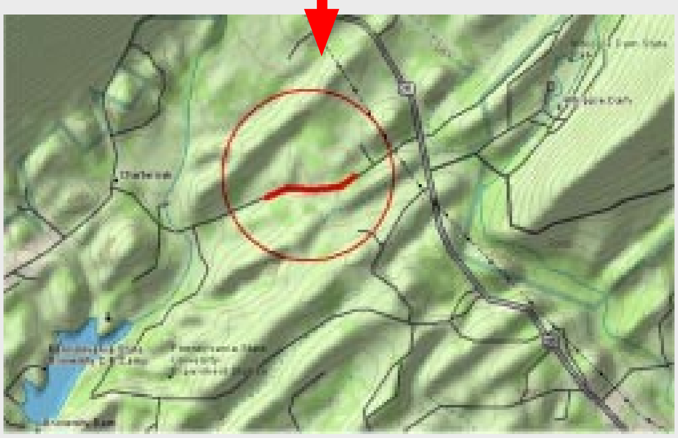
How to enjoy the outdoor classroom:

- Follow along with this brochure
- Look for matching numbered signs (The icon indicates picture location and direction)
- Stop and have a look around

red
rose
road

Site Location & Directions



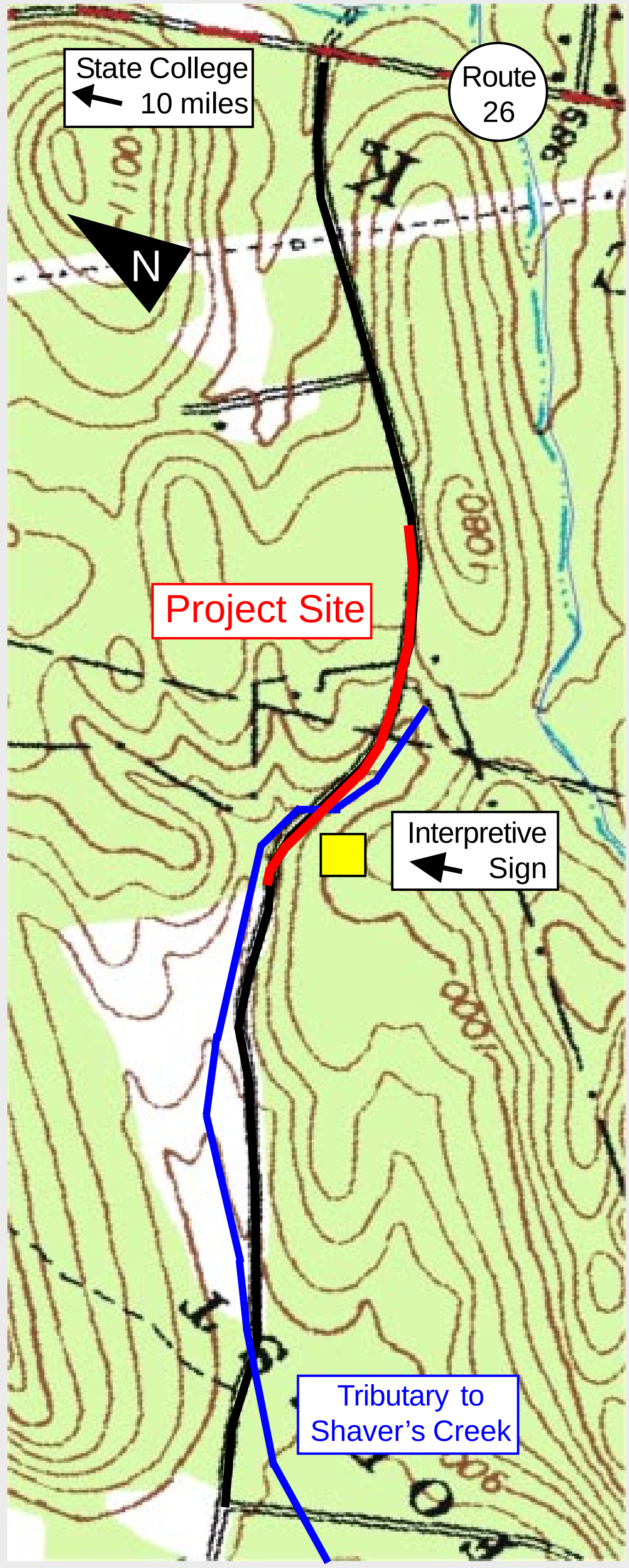


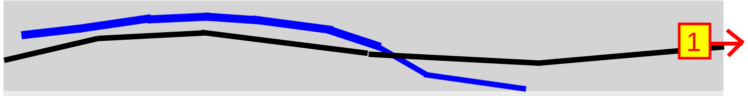
DIRECTIONS

RED ROSE ROAD is located in Huntingdon County 10 miles south of State College. From the north, take Rte. 26 south from State College. Red Rose Road is on the right 3.5 miles past the summit of Tussey Mountain. From the south, take Rte. 26 north from Huntingdon approximately 19 miles. Red Rose Road is the first road on the left after passing the entrance to Whipple Dam State Park.

red
rose
road

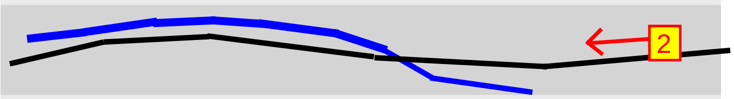
Site Map





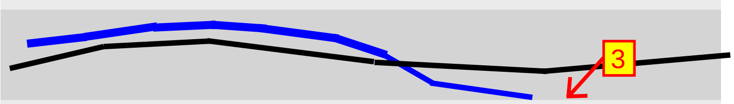
ENTRENCHED ROAD BEHAVES LIKE A DITCH

Years of wear and tear, machine maintenance and erosion caused the road surface to become entrenched below its banks. This captures all water from surface and near-surface drainage. The captured water gains energy as it flows down the road causing it to erode the road surface and side ditches. Road banks collapse into ditches mandating more machine work, which further lowers the road. Observe how the natural surface drainage has been restored by filling the road back to it original elevation and stopping the endless cycle of erosion and repair.



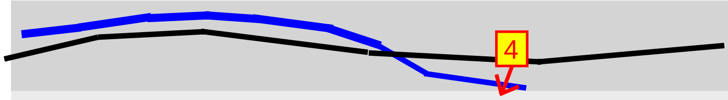
ERODED BANK & SHADE

In addition to the sunken road surface, notice the density of vegetation shown in this photo. The shade is so dense, plants whose roots could have held the bank's soil in place did not have enough light to grow. Also, look at how the treetops lean over the road shading it. Individual trees, which were not structurally sound or vigorous were removed. If not disrupted by deer browsing, vigorous strong young plants will now grow with more full light and provide protection for the soil. Trees growing close to the road will receive light from both sides and develop even crowns.



CONTRASTING DRAINAGE TURNOUTS

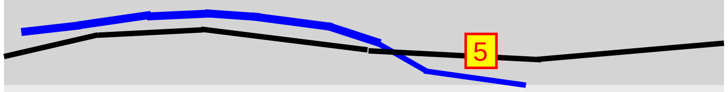
Road drainage constructed without concern for increasing environmental harm and maintenance costs frequently cuts banks vertically and makes steep drainage patterns. The maintenance practice at this location was to dig excess material out of the turnout and pile it beside the drainage course, constricting the width of flow causing the water to move faster and be more erosive. Now, observe how drainage from the restored road height does not require a ditch, and how flow is dispersed over a wide area at a shallow angle.



NATURAL ENERGY MANAGEMENT

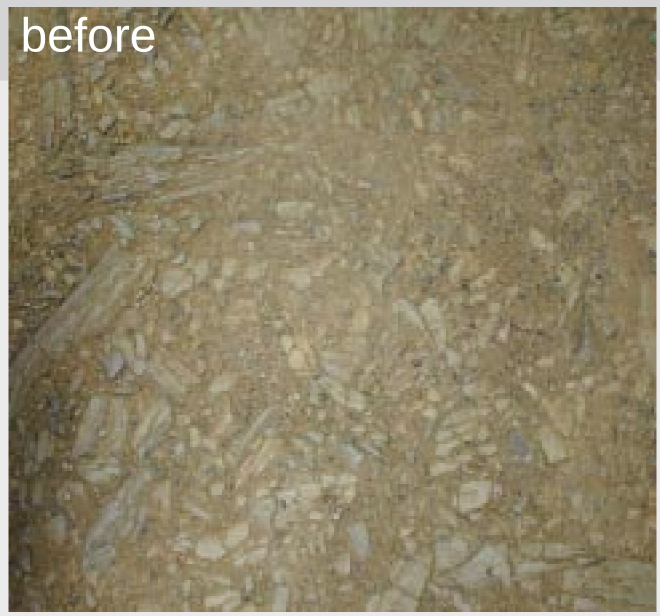
In a natural landscape it is difficult for water to concentrate. Organic material, including branches and logs, and rocks disrupt and slow the water's flow. Porous forest soils reduce the amount of surface runoff by allowing water to infiltrate.

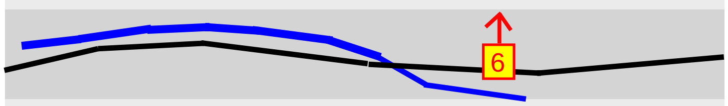
The natural pattern of organic debris was successfully emulated at the discharge end of this pipe. This simple use of organic materials not only dissipates the energy of the pipeflow but also provides life-supporting food for plant roots and the microbes living in conjunction with them. The roots, in turn, further stabilize the soil and increase infiltration.



MAINTAINABLE ROAD SURFACES

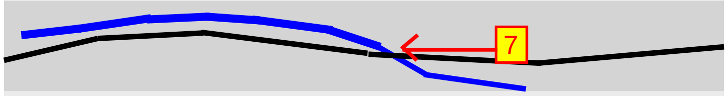
The bank-run shale used on the previous road surface had pieces in it that were too large for available grading machines to work into a drivable surface. Left un-graded, the road deteriorated. Shale has two other disadvantages. It "slacks," or breaks down into silt or clay soil particles when exposed to air, and it does not resist the abrasion of traffic well enough to be rated as a suitable road surface material. Clay and silt are the soil types most prone to make dust and sediment. The Driving Surface Aggregate visible now is a specially formulated mixture of abrasion resistant limestone. Contrast this surface with that of nearby off-site locations.





GRADE BREAK

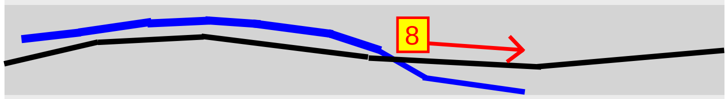
The pipe here was installed at an elevation high enough to allow the pipeflow to discharge at natural ground level. In order to get the required 12" of cover over the plastic pipe, a grade break was constructed. Grade breaks are inexpensive to build, easy to maintain, and serve several purposes. The additional road material used to construct the grade break provides cover for the pipe, slows traffic, and acts to divert water flowing down the road surface into the road ditch. This disruption of water flow prevents road deterioration from water movement on steep road grades and lengthens maintenance cycles.



HIGH-CAPACITY DITCH

The picture shows evidence of fast moving water. Tangled brush mattresses and large rocks washed clean indicate a strong erosive force generated by concentrated swift flow. Contrast how wide and deep the pictured ditch is compared to the present ditch.

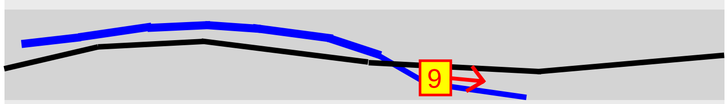
Large rocks were placed in the ditch before the road was filled in. Known as a “French Drain”, it serves to conduct clear sub-surface water downgrade without forcing it to come to the surface, where soil particles can be carried as unwanted sediment to the stream. To some extent, sub-drains help keep the road base drained, and therefore stronger.



BANK WASHOUT OVERLOADED DITCH

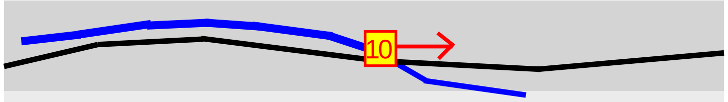
Concentrated flow washed out the road bank at this location sending a plume of sediment to the stream. Over time, that concentrated flow further eroded 400 ft. of ditchline discharging even more sediment directly into the stream.

A non-corroding cross-pipe was added under the road to harmlessly direct this flow to the forest floor on the other side of the road. The pipe entrance was raised to lessen the energy the water gained by falling into the pipe. On the other side, the pipe discharges at natural ground elevation. Dispersed there in a natural pattern, the water can infiltrate into the ground as if the road had never been built.



A STREAM AND ITS FLOODPLAIN

A stream will naturally form a channel with the width and depth to contain average flows while allowing naturally-occurring high flows to spill over its bank and onto its floodplain. By spreading high flows out over the floodplain, the excess energy and force of the water is released. Compare the size and shape of the stream channel here to that below the road crossing. The concentrated volumes and velocities of the road drainage have cut a deep gully-shaped channel disconnecting the stream from its floodplain thereby preventing energy dissipation. When all the energy of high flow events is confined within the channel, the cycle of repeated “down cutting” results.

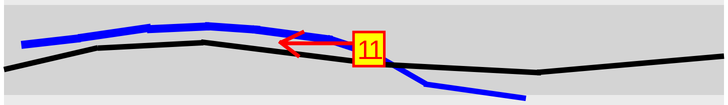


RAISING THE ROAD PROFILE

Excavated shale and limestone from the abandoned pit was trucked and spread on the entrenched road. A D-8 bulldozer crushed, spread and compacted the fill material.

<u>Work sequence was as follows:</u>

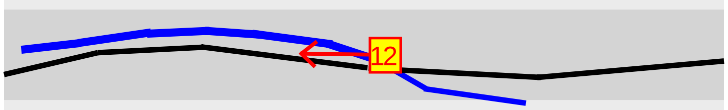
- Dump and spread stone of all sizes;
- Track over and crush material to 12” & less;
- Blade resistant larger stone to ditch line to create a subsurface French drain along road;
- Blade forward fines in approximate 8” lifts;
- Track compact and build surface shape into road with each lift, repeat until natural drainage is restored.



NEW ROAD LOCATION

Sediment from the original road, indicated on the photo at right, flowed directly to the adjacent stream reach. The road base would eventually have failed as storm flows continued to erode the stream banks. This is a very common problem wherever roads are located too close to streams.

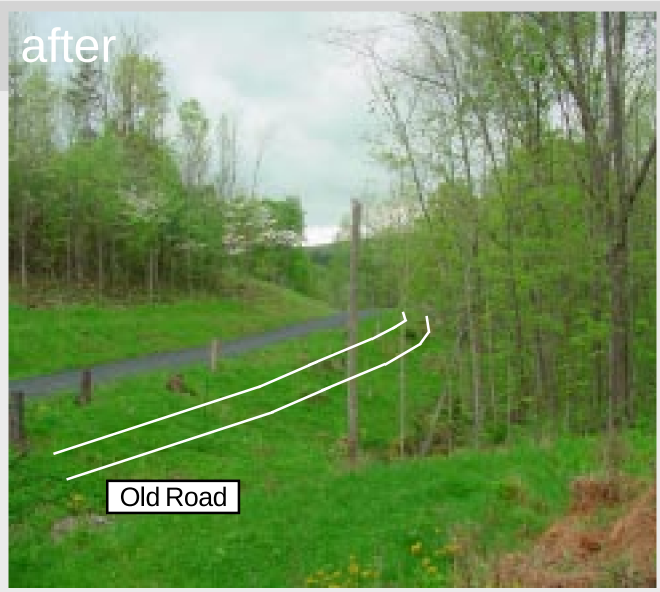
The road was relocated to demonstrate the value of respecting and using the forces of nature to correct long-term environmental problems. The pit was reclaimed, surface drainage was restored to its original pattern and a buffer zone was created between the road and the stream.

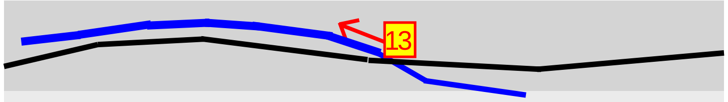


READY FOR NATURE TO ADOPT

Pictured here shortly after project completion is the newly created buffer area immediately after seeding and mulching. Note the naturalized uneven surface with stump, log and rock obstructions to overland water flow. High stumps were placed near the road to provide a visual marker of the road edge.

Contrast during your visit how growth patterns are influenced by water and leaves trapped upslope of the obstructions. As organic matter builds up from leaf litter, more water will be retained over these dry soils. In turn, the numbers of microbes and small creatures like earthworms will increase. As they do, growth capacity of this abandoned shale pit will increase.

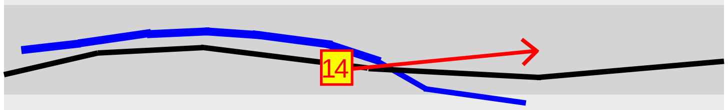




DESTRUCTIVE IMPACT ON STREAM

This section of stream channel should look similar to the stream channel above the road which is generally very stable, producing only small amounts of sediment from the bed and bank materials (# 9). The channel shape, characterized by a series of cascades and irregularly spaced scour pools, is normally 12-15 times wider than it is deep.

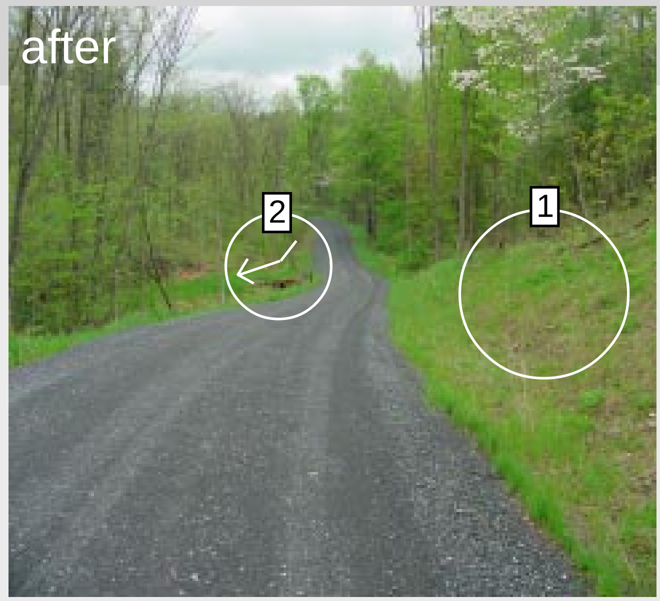
In contrast, the stream channel immediately below the road reflects the long-term effects of concentrated road drainage. Notice the severe down cutting that causes the channel to be deeper than it is wide and the complete physical separation of the stream from its floodplain.

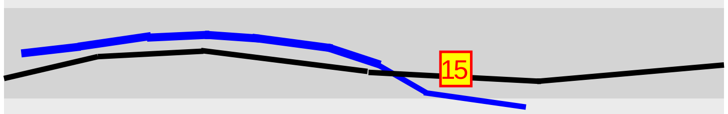


LOOKING EAST AT SHALE PIT

The road at its new alignment and elevation shows several features that prevent pollution. Compare this to previous photos.

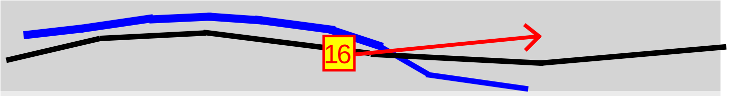
In the right foreground see the bank bench (1) and how it intercepts and redirects water toward the camera at a nearly level slope. On the left, the extra space between the road and the stream acts as an effective buffer. In the background, notice the ditch to the left (2) is located farther from the road preventing the bank drainage from mixing with road material.





AGGREGATE PLACEMENT

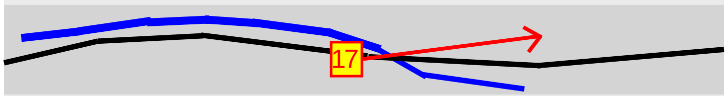
Drainage patterns such as crown and grade breaks, visible in the surface of the road, are reflected in every layer of fill to enhance subsurface water movement under the road base.The top layer is Driving Surface Aggregate (DSA), a specially formulated abrasion resistant mixture of crushed limestone. DSA has a carefully blended size distribution from 1½” stone to fine particles small enough to pass a screen with 200 holes per square inch. The fines act to fill all voids and create strength from increased density. Placement through a paving machine to a uniform 8” depth enables compaction with fines in place. This placement method avoids aggregate separation.



LOOKING EAST AT SHALE PIT

Easily available shale was periodically removed in uneven patterns, extending back over 120' to the right. It was taken from around the underlying hard limestone protrusions, shown here near the road. The road at this spot curved around the end of the abandoned pit, immediately adjacent to the stream (by the people in the photograph).

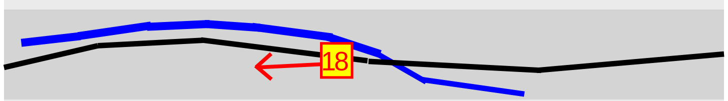
Contrast this "BEFORE" image with photos #12 and #14 showing the new road at its higher elevation and alignment. The actual point from which this photo (#16) was taken is now under 6' of fill and would be on the bank closest to the stream.



LOOKING EAST AT SHALE PIT

The steep bank on the right, shown being cleared of trees, is now under the left edge of the road. This bank was partially lowered, and the road was built at a steeper angle allowing it to pass over the old bank at a higher elevation.

These actions prevent the creation of a typical 1:1 uphill road bank or "cut" slope and the erosion consistently associated with such steep road banks. When native vegetation is thoroughly established, this more natural land shape will blend in with the beauty of the surrounding forests even better than pictured in photo #12.



WORK IN PIT

Excavating material from the abandoned pit produced fill to raise the road and correct the entrenched drainage pattern. By removing shale from the pit, a less steep and therefore less erodible profile was created. The more naturally appearing shape was formed with machinery normally used in roadwork.

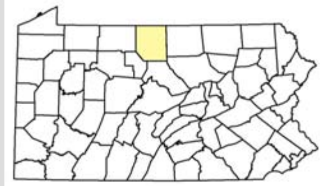
A D-8 bulldozer with ripping teeth and "U" blade loosened the shale and limestone domes left behind by the smaller machinery used to originally excavate the pit. A track hoe was used to load trucks, shape the final grade and set the stumps.

Worksite in Focus

Potter County

Horseshoe Road

6/10/04



Problem Identification

Routine maintenance operations and the wear and tear of traffic had the cumulative effect of lowering the road elevation in relation to the surrounding terrain (see photo). The resulting entrenched road trapped road drainage. Confined by the road, this water concentrated in parallel ditches and gained velocity. As the volume and velocity increased, more and more valuable road material was washed away, polluting nearby Pine Creek.

Project Objectives

1. Prevent direct discharge of sediment-laden road drainage to Pine Creek.
2. Reduce concentrated drainage from parallel ditches.
3. Filter road runoff using existing roadside vegetation.

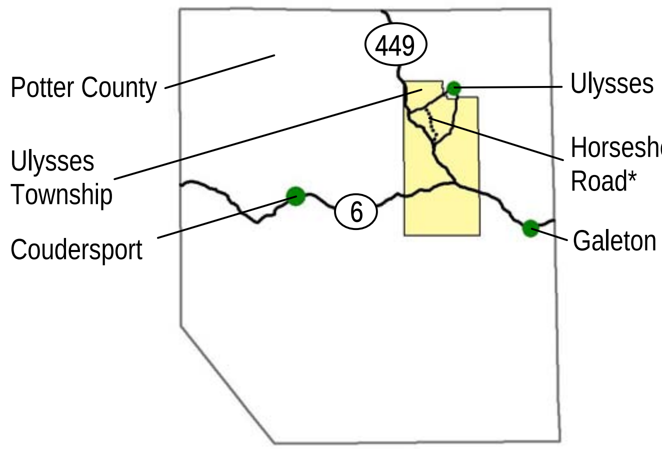
Project Considerations

Off right-of-way (ROW) drainage input from an adjacent driveway compounded the problems on Horseshoe Road. Existing drainage structures (ditches and crosspipes) were inadequate to handle flow volumes.

Spring seeps in the road bank drained directly onto the road surface resulting in a soft road base and observable ditchflow year-round.

Adequately addressing drainage on Horseshoe Road required an additional drainage outlet, installation of under-drain, and elevation of the road itself.

Project Statistics



Road:	Horseshoe Road
Road Owner:	Ulysses Township
Affected Watershed:	Pine Creek
Project Length:	1600 ft
Cost:	$53,829
Date Completed:	September 2002

Before: The entrenched road trapped road drainage resulting in fast-moving concentrated ditchflow. This water eroded road material and deposited it directly into Pine Creek.

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Project Solutions

Adding a cross-pipe: Installing a new cross-pipe on the road provided an extra drainage outlet and shortened the flow length of parallel road drainage. By minimzing the distance water has to travel before it is removed from the road corridor, the velocity and erosivity of the water are reduced.

Adding perforated underdrain: Underdrain, or drain tile, was added in the ditch to collect water flowing from spring seeps. This eliminated perennial ditchflow and corrected the soft road base problem.

Filling the road: The elevation of the road was raised by filling the road profile. The added elevation eliminated the need for parallel ditches and allowed drainage to sheet flow into the surrounding terrain through vegetated buffers, removing sediment-laden surface flow to Pine Creek.

Adequate Culvert Size: A hydrologic & hydraulic analysis was used to determine the proper size of the culvert needed for the stream crossing. The existing 30” round concrete pipe was replaced by a 77”x 52” squash pipe. The road was raised to ensure proper cover over the new pipe.

After: The road profile was raised eliminating ditchflow on the downslope side of the road. Drainage that was trapped on the entrenched road can now sheet flow freely off the road into surrounding vegetation. Because the water does not have the opportunity to gain velocity, its erosive potential is greatly reduced.

After: The pipe was re-sized and the road raised for proper cover over the new installation.

Cost Summary

Total Project Value:	$53,829
District Funding:	$31,769
Materials	$28,428
Contracted Work	$3,341
In-Kind from twp:	$22,060
Materials	$3,837
Labor & Equip.	$18,223

For More Information

The Center for Dirt and Gravel Road Studies
(814) 865-5355
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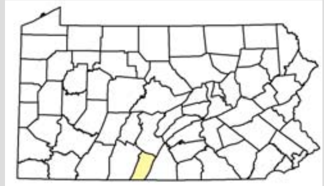
Potter County Conservation District
Eric Potter
(814) 274-8411

* Directions to Horseshoe Road worksite: From Coudersport: Take U.S. Route 6 east approximately 13 miles to State Highway 449. Follow 449 north to Brookland; just past Brookland veer right at the Y-junction onto SR 1001. Horseshoe Road (T450) is 4/10 of a mile ahead on the left.   The project begins at the intersection with SR 1001 and continues for 1600’.

Worksite in Focus

Fulton County
Dutch Corner Road
4/13/04



Problem Identification

Dutch Corner Road contributed concentrated, sediment-laden water to Patterson Run, a tributary of Licking Creek. Three primary issues caused this impairment: steep road slopes, deeply entrenched road segments, and significant off right-of-way (ROW) water inputs. Long steep road segments bordered by high banks on either side served to trap stormwater water increasing its volume and velocity thus making it highly erosive. Off ROW inputs from driveways and connecting paved roads contributed more water to already concentrated erosive flows.

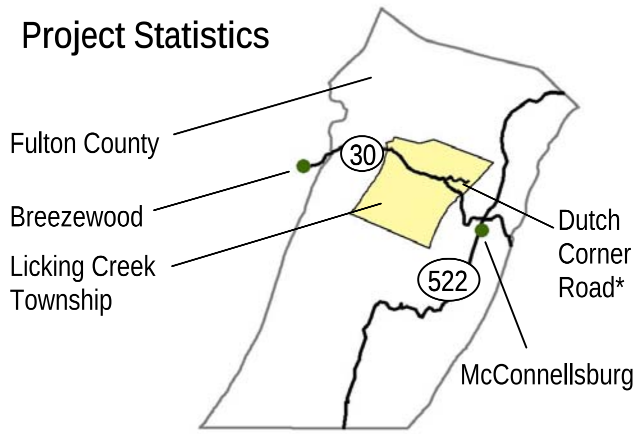
Project Objectives

1. Minimize the entrenchment of the road.
2. Separate off ROW drainage and prevent it from flowing onto the road.
3. Divide and minimize concentrated water flow on steep road segments.

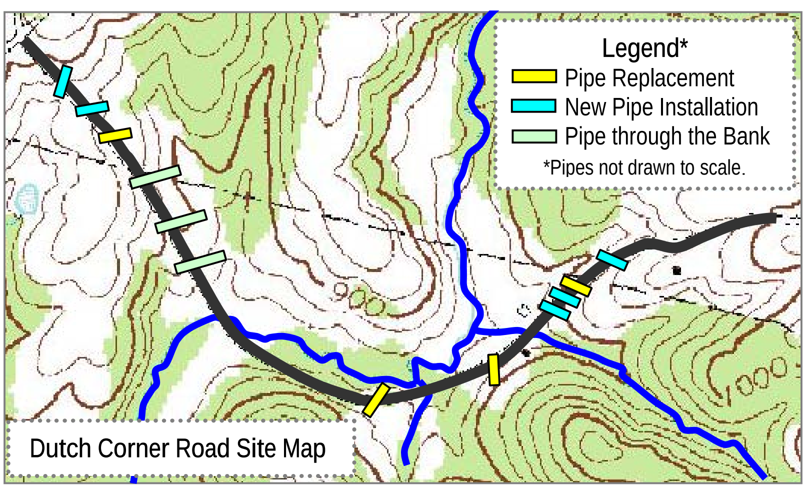
Project Considerations

The deep road entrenchment made raising the road elevation to the height of the surrounding landscape impractical and expensive. The topography lent itself on the steep entrenched road segments to pipe installation through the road banks at a slope of 2% and discharging road drainage on the other side of the bank. Drainage routed in this way is directed into adjacent vegetation where it encounters resistance, can release energy and infiltrate slowly.

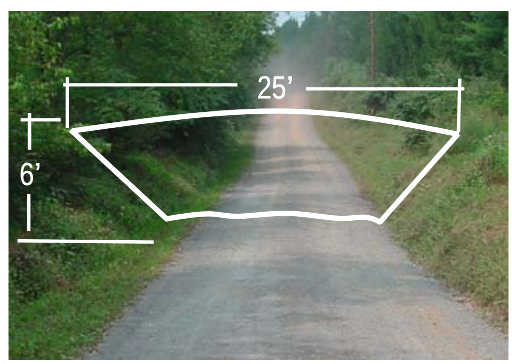
Project Statistics



Road:	Dutch Corner Rd
Road Owner:	Licking Creek Township
Length:	4,835 ft
Date Completed:	November 2003



Dutch Corner Road Site Map



Raising the road elevation to the elevation of the surrounding landscape was impractical because of the amount of material required (above).

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Before and After Shale Placement. Before, severely entrenched road slopes steeply to steam at the bottom of the hill. After, cross-pipes are added to divide drainage and reduce concentrated flow and the road elevation is raised 2' to cover the new pipes.

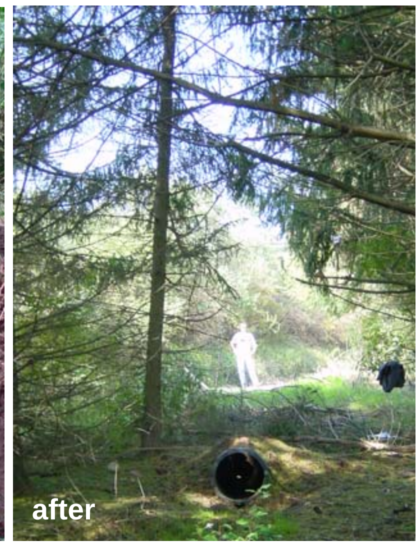
Project Solutions

Road profile. Shale was placed on steep entrenched areas to a maximum depth of 2 feet to obtain adequate cover on new crosspipes. Road surface was topped with Driving Surface Aggregate (DSA) for improved performance.

Adding crosspipes and installing pipes through the bank. 3 existing crosspipes were replaced and 9 new drainage pipes were added. 3 of the 9 were installed through the bank. Increased road drainage capacity minimizes concentrated flow before sufficient volume and velocity can build to strong erosive force.

Re-profiling driveways. Driveways were re-shaped at the point where they entered the roadway to eliminate any direct discharge to the road.

Grade breaks and broad-based dips. On steep driveways at points of concentrated flow, grade breaks and broad-based dips were installed to direct drainage off the driveway surface into surrounding vegetation for infiltration.



Pipes Through the Bank. Note the depth of the trench during construction. After construction the pipe has been covered and stabilized with vegetation.

Cost Summary

Total Project Value:	$70,962
District Funding:	$63,712
Materials	$46,970
Contracted Work & Equipment	$16,742
In-Kind from twp:	$7,250
Materials	$4000
Labor & Equipment	$3250

For More Information

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and Gravel Road Studies
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Conservation District
(717) 485-3547

* Directions: From U.S. 30: Take Breezy Point Road north 0.4 miles, turn right on Dutch Corner Road. Dutch Corner Road is located 12 miles east of Breezewood, 6 miles west of the intersection of U.S. 522 and U.S. 30 north of McConnellsburg.